

Appl No.: 10/053365

Response dated: February 6, 2009

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The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. **(previously amended)** A method of manufacturing an optical waveguide preform, said method comprising the steps of:

providing a first gaseous atmosphere including a first halogen-containing gas to a soot preform contained in a vessel, the first halogen-containing gas being selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ;

maintaining the first gaseous atmosphere between 1100 and 1300 °C, for a first reacting time sufficient to at least partially dope the soot preform, wherein the first halogen-containing gas has a partial pressure which decreases during the first reacting time, wherein no more than 0.5 slpm of the first gaseous atmosphere flows out of the vessel during the first reacting time, and wherein the first gaseous atmosphere is pressurized to a gage pressure of at least 0.1 atm gage during the first reacting time;

evacuating at least a portion of the first gaseous atmosphere from the vessel;

providing the vessel with a second gaseous atmosphere including a second halogen-containing gas, the second halogen-containing gas being selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ; and

maintaining the second gaseous atmosphere between 1100 and 1300 °C, for a second reacting time sufficient to further dope the soot preform, wherein the second halogen-containing gas has a partial pressure which decreases during the second reacting time, and wherein the second gaseous atmosphere is pressurized to a gage pressure of at least 0.1 atm gage during the second reacting time;

wherein the soot preform is retained in the vessel throughout and between: the step of maintaining the first gaseous atmosphere, the step of

evacuating at least a portion of the first gaseous atmosphere, the step of providing the second gaseous atmosphere, and the step of maintaining the second gaseous atmosphere.

2. **(previously amended)** The method of Claim 1 further including, following said step of maintaining second gaseous atmosphere:

providing the vessel with a third gaseous atmosphere including a third halogen-containing gas; and

maintaining the third gaseous atmosphere in the vessel for a third reacting time sufficient to further dope the soot preform, wherein the third halogen-containing gas has a partial pressure which decreases during the third reacting time, wherein the soot preform is retained in the vessel throughout and between: the step of maintaining the second gaseous atmosphere, the step of providing the third gaseous atmosphere, and the step of maintaining the third gaseous atmosphere.

3. **(previously amended)** The method of Claim 1 including depressurizing the first gaseous atmosphere about the soot preform at the end of the first reacting time.

4. **(cancelled)**

5. **(cancelled)**

6. **(cancelled)**

7. **(previously amended)** The method of Claim 1 wherein an inert gas is added to the atmosphere in the vessel during and between said steps of maintaining the first gaseous atmosphere and maintaining the second gaseous atmosphere.

8. **(previously presented)** The method of Claim 1 wherein a fluorine-containing gas selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 ,

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$C_2F_2Cl_2$, and F_2 is added to the atmosphere in the vessel during at least one of the first and second reacting times.

9. **(previously amended)** The method of Claim 1 further including the step of at least partially purging the vessel prior to said step of providing the vessel with the second gaseous atmosphere.

10. **(previously amended)** The method of Claim 1 wherein:
additional dopant gas is added to the atmosphere in the vessel during at least one of the first and second reacting times to compensate for the decreases in the partial pressure of the dopant gas resulting from reaction of the dopant gas with the soot preform.

11. **(original)** The method of Claim 1 including pressurizing an outer surface of the vessel to offset pressurization within the vessel.

12. **(original)** The method of Claim 1 including supporting a reinforcing sleeve about the vessel during at least the first and second reacting times.

13. **(original)** The method of Claim 1 including rotating the soot preform relative to the vessel and wherein the vessel is sealed.

14. **(previously amended)** The method of Claim 1 including:
drying the soot preform prior to said step of providing the first gaseous atmosphere; and
sintering the soot preform following the second reacting time.

15. **(cancelled)**

16. **(cancelled)**

17. **(previously amended)** The method of Claim 1 including:
 wherein the first gaseous atmosphere has a first pressure during the first
reacting time; and
 wherein the second gaseous atmosphere has a second pressure during the
second reacting time;
 wherein the second pressure is different than the first pressure.
18. **(previously amended)** The method of Claim 1 including increasing a
total pressure of the first gaseous atmosphere in the vessel during the first reacting time.
19. **(original)** The method of Claim 1 wherein the first reacting time is
between about 1 and 60 minutes.
20. **(original)** The method of Claim 1 wherein the second reacting time is
between about 1 and 60 minutes.
21. **(original)** The method of Claim 1 wherein the second reacting time is
longer than the first reacting time.
22. **(cancelled)**
23. **(previously amended)** The method of Claim 1 wherein the temperature
of the second gaseous atmosphere is different than the temperature of the first
gaseous atmosphere.
24. **(cancelled)**
25. **(cancelled)**
26. **(cancelled)**

27. (cancelled)

28. (cancelled)

29. (previously amended) The method of Claim 1 wherein the first and second gaseous atmospheres each include an inert gas selected from the group consisting of He, Ar, Ne, and N₂.

30. (previously amended) A method of manufacturing an optical waveguide preform, said method comprising the steps of:

providing a first gaseous atmosphere to a soot preform contained in a vessel, the first gaseous atmosphere including a fluorine-containing gas selected from the group consisting of SiF₄, SF₆, CF₄, C₂F₆, COF₂, C₂F₂Cl₂, and F₂;

maintaining the first gaseous atmosphere between 1100 and 1300 °C, for a first reacting time of between about 1 and 60 minutes to at least partially dope the soot preform, wherein the first fluorine-containing gas has a partial pressure which decreases during the first reacting time, wherein no more than 0.5 slpm of the first gaseous atmosphere flows out of the vessel during the first reacting time, and wherein the first gaseous atmosphere is pressurized to a gage pressure of at least 0.1 atm gage during the first reacting time;

evacuating at least a portion of the first gaseous atmosphere from the vessel at the end of the first reacting time; then

providing the vessel with a second gaseous atmosphere, the second gaseous atmosphere including a fluorine-containing gas selected from the group consisting of SiF₄, SF₆, CF₄, C₂F₆, COF₂, C₂F₂Cl₂, and F₂; and

maintaining the second gaseous atmosphere between 1100 and 1300 °C, for a second reacting time sufficient to further dope the soot preform, wherein the second fluorine-containing gas has a partial pressure which decreases during the second reacting time, and wherein the second gaseous atmosphere is

pressurized to a gage pressure of at least 0.1 atm gage during the second reacting time;

wherein the soot preform is retained in the vessel throughout and between: the step of maintaining the first gaseous atmosphere, the step of evacuating at least a portion of the first gaseous atmosphere, the step of providing the vessel with the second gaseous atmosphere, and the step of maintaining the second gaseous atmosphere .

31. **(cancelled)**

32. **(previously amended)** The method of Claim 30 including the step of depressurizing the first gaseous atmosphere about the soot preform at the end of the first reacting time.

33. **(previously amended)** The method of Claim 32 wherein the vessel is substantially completely gas-sealed throughout both of said steps of maintaining the first and second gaseous atmospheres.

34. **(previously amended)** The method of Claim 32 further including, following said step of depressurizing the doping atmosphere, the steps of:

replacing at least a portion of the first gaseous atmosphere with a second gaseous atmosphere about the soot preform, the second gaseous atmosphere being selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ; and

pressurizing the second gaseous atmosphere about the soot preform, and maintaining the second gaseous atmosphere between 1100 and 1300 °C, for a second reacting time of no more than 60 minutes to further dope the soot preform.

35. **(previously amended)** The method of Claim 34 wherein said step of pressurizing the second gaseous atmosphere includes pressurizing the second gaseous atmosphere to a gage pressure of at least 0.1 atm.

36. **(previously amended)** The method of Claim 35 wherein said step of pressurizing the second gaseous atmosphere includes pressurizing the second gaseous atmosphere to a gage pressure of at least 0.5 atm.

37. **(original)** The method of Claim 34 wherein the second reacting time is between about 5 and 30 minutes.

38. **(previously amended)** The method of Claim 34 wherein said step of pressurizing the second gaseous atmosphere includes heating the second gaseous atmosphere to a temperature of between about 1125 and 1300 °C.

39. **(previously amended)** The method of Claim 30 including pressurizing an outer surface of the vessel to offset the pressurizing within the vessel.

40. **(original)** The method of Claim 30 including rotating the soot preform relative to the vessel.

41. **(previously amended)** The method of Claim 30 including:
drying the soot preform prior to said step of providing the first gaseous atmosphere; and
sintering the soot preform following the first reacting time.

42. **(cancelled)**

43. **(cancelled)**

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44. **(previously amended)** The method of Claim 30 wherein the first gaseous atmosphere has a gage pressure of at least 0.5 atm gage.

45. **(previously amended)** The method of Claim 30 wherein the first reacting time is between about 5 and 30 minutes.

46. **(cancelled)**

47. **(cancelled)**

48. **(cancelled)**

49. **(cancelled)**

50. **(cancelled)**

51. **(currently amended)** A method of manufacturing an optical waveguide preform, said method comprising the steps of:

flowing a process gas into a vessel to provide a gaseous atmosphere in the vessel about a soot preform, the process gas including a first gas selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ;

~~contacting the soot preform with the gaseous atmosphere, and~~
maintaining the gaseous atmosphere between 1100 and 1300 °C, for a reacting time sufficient to at least partially dope the soot preform, wherein the first gas has a partial pressure which decreases during the reacting time, wherein no more than 0.5 slpm of the gaseous atmosphere flows out of the vessel during the reacting time, and wherein the gaseous atmosphere is pressurized about the soot preform to greater than ambient pressure during the reacting time; and

evacuating at least a portion of the gaseous atmosphere from the vessel at the end of the reacting time.

52. **(previously presented)** The method of claim 51 further including flowing a makeup gas into the vessel during the reacting time.

53. **(previously amended)** The method of claim 52 wherein the flow rate of the makeup gas is provided to at least partially offset for any pressure loss due to the first gas reacting with the preform.

54. **(cancelled)**

55. **(cancelled)**

56. **(previously amended)** The method of claim 51 including flowing an additional amount of the process gas into the vessel to form a second gaseous atmosphere in the vessel about the soot preform following said step of evacuating at least a portion of the gaseous atmosphere from the vessel, wherein the soot preform is retained in the vessel throughout and between the step of flowing the process gas into the vessel, the step of maintaining the gaseous atmosphere, the step of evacuating at least a portion of the gaseous atmosphere, and the step of flowing an additional amount of the process gas into the vessel.

57. – 131 **(cancelled)**

132. **(currently amended)** A method of manufacturing an optical waveguide preform, said method comprising the steps of:

providing a soot preform contained in a vessel;

adding a quantity of a first gas to the vessel to provide a first gaseous atmosphere to the soot preform, the first gas being selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ;

~~contacting the soot preform with the first gaseous atmosphere within the vessel,~~
and maintaining the first gaseous atmosphere between 1100 and 1300 °C, for a first reacting time sufficient to at least partially dope the soot preform, wherein the first gas

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has a partial pressure which decreases during the first reacting time, wherein the first gaseous atmosphere is pressurized to a first pressure greater than ambient pressure, and wherein no more than 0.5 slpm of the first gaseous atmosphere flows out of the vessel during the first reacting time; then

adding a quantity of a second gas to the vessel to provide a second gaseous atmosphere to the soot preform, the second gas being selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ; and

~~contacting the soot preform with the second gaseous atmosphere within the vessel, and maintaining the second gaseous atmosphere between 1100 and 1300 °C, for a second reacting time sufficient to at least partially dope the soot preform, wherein the second gas has a partial pressure which decreases during the second reacting time, wherein the second gaseous atmosphere is pressurized to a second pressure greater than ambient pressure, and wherein no more than 0.5 slpm of the second gaseous atmosphere flows out of the vessel during the second reacting time ;~~

wherein the soot preform is retained in the vessel throughout and between the step of adding a quantity of a first gas, the step of maintaining ~~contacting the soot preform with the first gaseous atmosphere~~, the step of adding a quantity of a second gas, and the step of maintaining ~~contacting the soot preform with the second gaseous atmosphere~~.

133. **(previously presented)** The method of claim 132 wherein the vessel is sealed gas-tight throughout the first reacting time.

134. **(previously presented)** The method of claim 133 wherein the vessel is sealed gas-tight throughout the second reacting time.

135. **(previously amended)** The method of claim 132 wherein at least a portion of the first gaseous atmosphere is evacuated from the vessel at the end of the first reacting time.

136. **(previously amended)** The method of claim 132 wherein at least a portion of the second gaseous atmosphere is evacuated from the vessel at the end of the second reacting time.

137. **(previously amended)** The method of claim 132 wherein no more than 0.1 slpm of the first gaseous atmosphere flows out of the vessel during the first reacting time.

138. **(previously amended)** The method of claim 132 wherein no more than 0.1 slpm of the second gaseous atmosphere flows out of the vessel during the second reacting time.

139. **(previously amended)** A method of manufacturing an optical waveguide preform, said method comprising the steps of:

providing a soot preform contained in a vessel;

adding a quantity of a first fluorine-containing gas to the vessel to provide a first gaseous atmosphere to the soot preform, the first gas being selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ; then,

sealing the vessel gas-tight and maintaining the first gaseous atmosphere between 1100 and 1300 °C, for a first reacting time sufficient to dope the soot preform, wherein the first gas has a partial pressure which decreases during the first reacting time as the soot preform is doped, wherein the first gaseous atmosphere is pressurized to a first pressure greater than ambient pressure during the first reacting time; then,

evacuating at least a portion of the first gaseous atmosphere from the vessel; then,

adding a quantity of a second fluorine-containing gas to the vessel to provide a second gaseous atmosphere to the soot preform, the second gas being selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ; then,

sealing the vessel gas-tight and maintaining the soot preform in contact with the second gaseous atmosphere within the vessel, and maintaining the second gaseous atmosphere between 1100 and 1300 °C, for a second reacting time sufficient to further

dope the soot preform, wherein the second gas has a partial pressure which decreases during the second reacting time as the soot preform is doped, wherein the second gaseous atmosphere is pressurized to a second pressure greater than ambient pressure during the second reacting time;

wherein the soot preform is retained in the vessel throughout and between the step of adding a quantity of a first fluorine-containing gas, the step of sealing the vessel gas-tight and maintaining the soot preform in contact with the first gaseous atmosphere, the step of evacuating at least a portion of the first gaseous atmosphere from the vessel, the step of adding a quantity of a second fluorine-containing gas, and the step of sealing the vessel gas-tight and maintaining the soot preform in contact with the second gaseous atmosphere.

140. **(previously amended)** A method of manufacturing an optical waveguide preform, said method comprising the steps of:

providing a soot preform contained in a vessel;

adding a quantity of a first fluorine-containing gas to the vessel and in contact with the soot preform to provide a first gaseous atmosphere to the soot preform, the first gas being selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ; then,

interrupting the adding of the first fluorine-containing gas into the vessel and maintaining the soot preform in contact with the first gaseous atmosphere within the vessel, and maintaining the first gaseous atmosphere between 1100 and 1300 °C, for a first reacting time sufficient to dope the soot preform, wherein the first gas has a partial pressure which decreases during the first reacting time as the soot preform is doped, wherein the first gaseous atmosphere is pressurized to a first pressure greater than ambient pressure during the first reacting time; then,

evacuating at least a portion of the first gaseous atmosphere from the vessel; then,

adding a quantity of a second fluorine-containing gas to the vessel to provide a second gaseous atmosphere to the soot preform, the second gas being selected from the group consisting of SiF_4 , SF_6 , CF_4 , C_2F_6 , COF_2 , $\text{C}_2\text{F}_2\text{Cl}_2$, and F_2 ; then,

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interrupting the adding of the second fluorine-containing gas into the vessel and maintaining the soot preform in contact with the second gaseous atmosphere within the vessel, and maintaining the second gaseous atmosphere between 1100 and 1300 °C, for a second reacting time sufficient to further dope the soot preform, wherein the second gas has a partial pressure which decreases during the second reacting time as the soot preform is doped, wherein the second gaseous atmosphere is pressurized to a second pressure greater than ambient pressure during the second reacting time;

wherein the soot preform is retained in the vessel throughout and between the step of adding a quantity of a first fluorine-containing gas, the step of interrupting the adding of the first fluorine-containing gas and maintaining the soot preform in contact with the first gaseous atmosphere, the step of evacuating at least a portion of the first gaseous atmosphere from the vessel, the step of adding a quantity of a second fluorine-containing gas, and the step of interrupting the adding of the second fluorine-containing gas and maintaining the soot preform in contact with the second gaseous atmosphere.